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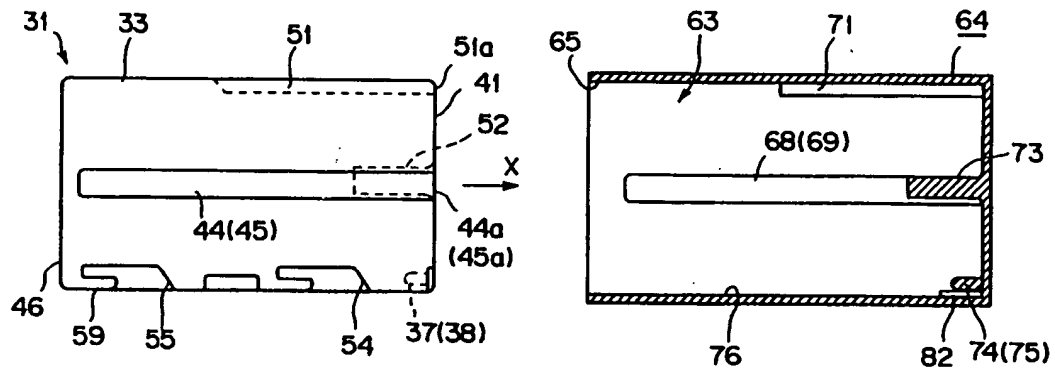
(54) Battery device and electronic equipment employing the battery device as power source.

(57) A battery device (31) houses four tubular cells in juxtaposition to each other in vertical and transverse directions. The battery device (31) has a housing unit (33) having a cell housing unit (32), a plurality of cells (1) housed within said cell housing unit, first and second grooves (44, 45) formed on both lateral surfaces of the cell housing unit for extending parallel to the direction of insertion of the housing unit into an electronic equipment, at a mid height along the height of the cell housing unit at right angles to the direction of insertion, and a third groove (51) formed at a mid position along the width of the housing unit for extending from the forward end face (41) as far as a mid portion of the housing unit. The first and second grooves (44, 45) are opened in a forward end face (41) of the housing unit in the direction of insertion. The battery device (31) also has a hole (52) formed in a portion of the forward end face of the housing unit not opposed by the end

faces of the cells (1) housed within the housing unit. An electronic equipment (61) on which the battery device (31) is loaded has a battery loading section (63) dimensioned to hold the battery device. The battery loading section (63) has, on its opposite inner surfaces, first and second ribs (68, 69) engaged by the first and second grooves (44, 45) in the battery device and a third rib (71) engaged by the third groove (51) of the battery device. The battery loading device also has an engagement boss (73) on an end face (72) of the battery loading section lying in the inserting direction of the battery device. The engagement boss (73) is engaged in a hole (52) formed in the forward end face of the housing unit of the battery device. In the electronic equipment (61), a battery device housing four cells and a battery device housing two cells can each be loaded at a selectively set loading position.

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FIG.10



## BACKGROUND OF THE INVENTION

This invention relates to a battery device having a chargeable secondary cell or a primary cell such as a dry cell in its housing member, and an electronic equipment such as a video camera or a video tape recorder employing the battery device as a power source.

In a portable electronic equipment, such as a video camera, video tape recorder, tape player or a disc player, a dc power source such as a rechargeable battery or a dry cell is adapted to be used in addition to a commercial power source supplied via a dc adapter.

With the battery device, a battery loading unit is mounted at a portion of a main body of the equipment, and a battery device housing a rechargeable cell or a dry cell is loaded on the battery loading unit. The battery device having the rechargeable cell enclosed therein is loaded on a charger having a dc adapter for charging.

The battery device employed in an electronic equipment such as a video camera or a video tape recorder has a housing unit for housing plural batteries in order to procure a voltage sufficient to drive the electronic equipment or a capacity sufficient to drive the electronic equipment for longer than a preset time period. This type of the battery device has a housing unit having two rechargeable cells arrayed side-by-side therein.

The battery device 2, having two cylindrically-shaped rechargeable cells 1, 1, has a housing unit 4 having a cell housing section 3 having a size sufficient to hold two rechargeable cells 1, 1 side-by-side therein, as shown in Fig.26. The housing unit 4 is molded of synthetic resin and is adapted to hold cells 1, 1 arranged side-by-side in the cell housing unit 3 in a hermetically sealed condition, as shown in Fig.27. The two cells 1, 1, housed within the housing unit 4, are connected in series with each other via an electrode plate, not shown, in the cell housing unit 3.

The bottom side of the housing unit 4, housing the two cells 1 in a side-by-side relation in the cell housing unit 3, is integrally formed with a terminal connecting plate 7 having embedded therein a positive terminal plate 5 and a negative terminal plate 6 for electrical connection to a connection terminal of an electronic equipment on which the battery device 2 may be loaded, and having a connection line, not shown, electrically connecting the positive and negative terminals 5 and 6 to the electrode plate 7. The positive terminal 5 and the negative terminal 6, provided on the terminal mounting plate 7, are adapted to be electrically connected to pin-shaped connection terminals provided on the electronic equipment on which the battery device 2 is to be loaded. The tubular-

shaped positive and negative terminals 5, 6 are mounted on both sides of the terminal mounting plate 7 for facing an end face 8 which is the loading side of the battery device 2 into the electronic device, as shown in Fig.29.

The tubular-shaped positive and negative terminals 5 and 6 are mounted at both sides of the terminal mounting plate 7 with opening ends 5a, 6a thereof facing the end face of the battery device 2 along the loading direction of the electronic equipment.

The above-described battery device 2 is substantially rectangular in shape in keeping with the outer shape of the two cells 1, 1 arranged side-by-side. Both sides of an upper surface 9 of the housing unit 4 opposite to its bottom surface formed as one with the terminal mounting plate 7, are formed as arcuate portions 10, 10 conforming to the outer peripheral surface of the cells 1, 1. The battery device 2 thus formed with the arcuate portions 10, 10 on its upper surface is vertically non-symmetrical in shape so that its vertical direction can be discerned easily.

The above-described battery device 2 may be loaded so as to be housed within a battery loading unit 14 formed in a portion of an outer casing 13 of a video camera 12, as shown in Fig.29. That is, the battery housing unit 14 having a size sufficient to hold the battery device 2 in its entirety is formed at a portion of an outer casing 13. The battery loading section 14 is formed by partitioning a portion of the outer casing 13 and has a pair of connecting pins 17, 18 on its inner wall surface facing an entrance/exit opening 15 for the insertion or removal of the battery device 2. The connecting pins 17, 18 are adapted to be respectively connected to the positive terminal 5 and the negative terminal 6 provided on the battery device 2.

The battery device 2 is loaded on the battery loading section 14 by being inserted in a direction shown by arrow A in Fig.29 via an entrance/exit opening 15, as indicated by arrow A in Fig.29, with the end face 8, on which the opening ends 5a, 6a of the positive terminal 5 and the negative terminal 6 are opened, foremost. At this time, the positive terminal 5 and the negative terminal 6 are connected to the connecting pins 17, 18 and the battery device 2 is electrically connected to the video camera 12 so that the power of the cells 1,1 may be fed to the video camera 12.

The housing unit 4 of the battery device 2 has a mistaken-insertion inhibiting groove 11 in its upper surface 9 for prohibiting mistaken insertion into the battery housing unit 14, as shown in Figs.26 and 27. The mistaken-insertion inhibiting groove 11 is opened at 11a in the inserting side end face 8 of the battery device 2 into the battery loading section 14 and is formed parallel to the loading direction

with respect to the battery loading section 14. On the inner lateral surface of the battery loading section 14 is formed a rib 19 for extending from the entrance/exit opening 15 as far as its mid portion so as to be engaged in the mistaken-insertion inhibiting groove 11. By providing the mistaken-insertion inhibiting groove 11 at the battery device 2 and by providing the rib 19 engaged in the mistaken-insertion inhibiting groove 11 at the battery loading device 14, the battery device 2 can be loaded on the battery loading section 14 only when the battery device is loaded with the rib 19 in registration correctly with the mistaken-insertion inhibiting groove 11, thus inhibiting mistaken insertion of the battery device into the battery loading section 14.

There is also proposed a second battery device 22 having a housing unit 4 further housing a second row of two series-connected cells 1 and thus housing four cells 1, as shown in Fig.30. With the second battery device 22, the first row of two juxtaposed cells 1, 1 stacked on the second row of two juxtaposed cells 1, 1, are housed in their entirety in the housing unit 24, as shown in Fig.31. The second battery device 22 having the two by two cells arranged side-by-side in the housing unit 4 has the constitution of the terminal mounting plate 7 in common with the first battery device 2 housing the two cells 1, 1, in which the positive terminal 5 and the negative terminal 6 are embedded in the terminal mounting plate 7 and are connectable to the connecting pins 17, 18 provided on the video camera 12. Since the second battery device 22 shown in Figs.30 and 31 has the first row of two juxtaposed cells 1, 1 stacked on the second row of two juxtaposed cells 1, 1, the second battery device differs from the first battery device 2 only with respect to the height  $H_1$  and has the width  $W_1$  in common with the first battery device, with the two battery devices being substantially similar in shape to each other. Since the two battery devices are substantially similar in shape to each other in this manner, the mistaken-insertion inhibiting groove 11 for preventing mistaken insertion into the battery loading section may be of the similar constitution for both the first and second battery devices 2 and 22.

In addition, since the second battery device 22 is housed within the housing unit 24 with two cells 1, 1 arranged in two rows, the cell housing efficiency may be improved to reduce the size of the device 22 so that the battery loading section of the electronic equipment on which the battery device 22 is loaded may also be reduced in size.

Meanwhile, it is desirable that the first battery device 2 housing two cells 1 and the second battery device 22 housing the four cells be selectively loadable on a common electronic equipment. For

example, if the video camera 12 is employed for a prolonged time or a shorter time, it is desirable to load the second battery device 22 housing the four cells and to load the first battery device 2 housing two cells, respectively, in view of operability of the video camera 12.

For such selective loading of the first battery device 2 housing the two cells 1 or the second battery device 22 housing the four cells 1, it is necessary to design the battery loading section having a size sufficient to hold the large-sized second battery device 22 in its entirety, as shown in Fig.32.

The second battery device 22 houses the two juxtaposed cells stacked on two juxtaposed cells, with the four cells being cylindrical in shape and of the same size and with an end face 28 thereof being substantially square, as shown in Fig.31. Thus a diagonal line  $S_1$  of the end face 28 is substantially equal to a width  $W_1$  of the first battery device 2. Thus, if it is attempted to load the small-sized first battery device 2 into a battery loading section 25 capable of loading the large-sized second battery device 22, the first battery device 2 can be loaded not only in the normal loading position in which it is inserted with the terminal mounting plate 7 in contact with the bottom surface 25a of the battery loading section 25 and with the positive terminal 5 and the negative terminal 6 being connected to the connection pins 17, 18 within the battery loading section 25, but also in the inclined position along the diagonal direction of the battery loading section 25, as shown with a chain-dotted line and double-dotted chain line in Fig.33. In addition, the first battery section 2 can be loaded with its upper surface 9 extending along the upper surface 25b of the battery loading section 25, as indicated by a broken line in Fig.33. If the first battery device 2 is loaded with a tilt relative to the battery loading section 25 or with an offset towards the upper surface 25b, the positive and negative terminals 5, 6 cannot be connected to the connecting pins 17, 18 of the battery loading section 25, as a result of which the first battery device 2 is in the mistaken loading state in which electrical connection cannot be established with the video camera.

On the other hand, since the cell is heavier than the components making up the electrical equipment, the battery device housing the cells is increased in weight. Above all, the battery device having plural cells housed within a housing unit is increased in weight depending on the number of the cells housed therein. It becomes difficult to load the battery device housing plural cells, and having an increased weight, onto the battery loading section with correct positioning and orientation. If the battery device having a large weight is loaded onto the battery loading section without correct

positioning and is oscillated in the electronic equipment on which it is loaded, a large impact is applied to the electronic equipment on which the battery device is loaded, thus causing the risk that the electronic equipment is occasionally damaged. Above all, the connection terminals interconnecting the battery device and the electronic equipment may be easily damaged by such impact.

#### OBJECT AND SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a battery device which can be loaded with correct positioning on an electronic equipment to assure sufficient protection of the electronic equipment.

It is another object of the present invention to provide a battery device which can be loaded reliably without the risk of mistaken insertion on a battery loading section of an electronic equipment capable of selectively loading battery devices housing a different number of cells and having different sizes.

It is a further object of the present invention to provide a battery device which can be loaded with correct positioning on a battery loading section capable of selectively loading battery devices having different sizes.

It is a further object of the present invention to provide a battery device capable of protecting connection terminals for interconnection and assuring safe and reliable interconnection of the connection terminals.

It is a further object of the present invention to provide an electronic equipment having a battery loading section capable of selectively loading battery devices having different sizes.

It is a further object of the present invention to provide an electronic equipment capable of protecting the battery device and the connection terminals for interconnection provided in the battery loading section and assuring safe and reliable loading and unloading of the battery device.

In one aspect, the present invention provides a battery device having a housing unit having a cell housing unit, first and second grooves being formed on, and extending longitudinally along, respective lateral surfaces of the cell housing unit at a mid height thereof. The first and second grooves have opening ends in their forward end faces.

Preferably, the battery device also includes a third groove on a surface extending substantially at right angles to the forward end face and opposite lateral sides of the housing unit, at a mid position along the width of the housing unit. The third groove is opened in the forward end face of the housing unit and extends from the forward end face as far as a mid portion of the housing unit.

Preferably, the battery device also includes a hole formed in a portion of the forward end face of the housing unit which is not opposed by end faces of cells when cells are housed within the housing unit.

The housing unit may be dimensioned to hold two by two juxtaposed tubular cells in parallel in vertical and transverse directions.

In a case of a battery device in which the housing unit is adapted to hold two by two juxtaposed tubular cells in two rows in two tiers, the first, second and third grooves are preferably formed in spaces defined in the cell housing unit between the cells arranged in juxtaposition and parallel to each other.

Preferably, the battery device of the invention has cells sealed in the cell housing unit thereof.

In the case of a battery device according to the present invention adapted for insertion into electronic equipment, connection terminals for electrical connection to connection terminals provided on the electronic equipment are provided on the forward end face of the housing unit in the direction of insertion into the electronic equipment.

In another aspect, the present invention provides an electronic equipment having a main body having a battery loading section dimensioned to hold therein an insertable battery device having a cell housing section for holding four juxtaposed tubular cells in two rows in two tiers. First and second ribs are formed on opposite inner lateral sides of the battery loading section for engagement by first and second grooves on the battery device.

Preferably, a third rib is formed on a surface of the battery loading section extending substantially at right angles to the opposite lateral sides of the battery loading section and in parallel with the direction of insertion of the battery device. The third rib is for engagement in a third groove formed in a surface of the housing unit of the battery device extending substantially at right angles to both lateral sides of the housing unit in parallel with the direction of insertion of the battery device into the battery loading section.

An engagement boss, for engagement in a hole formed in the forward end face of the housing unit of the battery device, may be provided on an end face of the battery loading section lying in the inserting direction of the battery device.

Connection terminals for electrical connection to connection terminals provided on the forward end face of the battery device are formed on the end face of the battery loading section facing the inserting direction for the battery device.

The connection terminals provided on the battery device and the battery loading device preferably are connection pins and tubular connection terminals engaged by the connection pins. In such

a case, the engagement boss for engagement in the hole formed in the battery device is longer in length than the connection pins or the tubular connection terminals provided in the battery device or in the battery loading section.

The battery device according to the present invention is loaded in position on the battery loading section of the electronic equipment by engagement of the first and second grooves formed in the battery device housing unit with the ribs provided on the battery loading section.

The battery device having the first and second grooves closed on rear end faces with respect to the direction of insertion can be loaded on the battery loading section only when the forward end face of the battery device is foremost during insertion. The battery device cannot be inserted when it is about to be inserted in the opposite direction since a portion of the opposite end face is then abutted against the rib formed on the battery device. On the other hand, the battery device cannot be inserted in the vertically topsy-turvy state if a rib for engagement in the third groove formed in the housing unit is formed on the battery loading section.

The battery device having a hole extending parallel to the direction of insertion on the portion of the forward end face of the housing unit which is not opposed by the end faces of cells when cells are housed in the cell housing section may be loaded in position on the battery loading section by providing an engagement boss on the battery loading section so as to be engaged in the hole. Since the hole engaged by the engagement boss acts as an insertion guide during loading of the battery device on the battery loading section, there is no necessity that the outer surface of the housing unit act as an insertion guide so that there is no risk of scratches being formed on the outer surface of the housing unit.

When the battery device is one adapted to have four tubular cells housed within the cell housing unit with the cells neighboring to each other in two rows in two tiers, the first and second grooves formed in the battery device are engaged by first and second ribs formed on the inner lateral sides of the battery loading section. The battery device may be loaded in position on the electronic equipment by inserting the battery device with the ribs acting as the guide and by engaging the ribs in the first and second grooves.

When the four-cell battery device is loaded, the third groove formed in the battery device is engaged by the third rib. If it is attempted to insert the four-cell battery device in a vertically topsy-turvy state, the third rib is abutted against a portion of the forward end face of the housing unit for prohibiting mistaken insertion.

If the four-cell battery device is inserted into the battery loading section of the electronic equipment so that the forward end face having the hole is foremost, the connection terminals on the battery device are engaged with the connection terminals on the electronic equipment for establishing electrical connection. With the electronic equipment, since the engagement boss engaged in the hole formed in the battery device is longer in length than the connection pins or the tubular connection terminals provided in the battery device or in the battery loading section, the connection pins and the connection terminals are interconnected after the engagement boss is engaged in the hole for positioning the battery device with respect to the battery loading section.

In addition, if the battery device is inserted into the battery loading section so that the planar end face thereof, opposite to the end face having the hole, is foremost, the planar end face is caused to bear against the engagement boss provided in the battery loading section for inhibiting further insertion of the battery device for inhibiting mistaken insertion.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view showing a battery device according to the present invention.

Fig. 2 is a side view showing a battery device according to the present invention.

Fig. 3 is a transverse cross-sectional view of a battery device according to the present invention.

Fig. 4 is a front view of a battery device according to the present invention.

Fig. 5 is a perspective view of a battery device of the present invention, as viewed from the bottom side.

Fig. 6 is a perspective view of a video camera as an electronic equipment having a battery loading section capable of loading both the battery device according to the present invention and a first battery device housing two cells.

Fig. 7 is a perspective view showing a casing having a battery loading section provided on a video camera.

Fig. 8 is a cross-sectional view of the casing showing the battery loading section.

Fig. 9 is a front view of the casing showing the battery loading section.

Fig. 10 is a side view showing the state of loading the battery device on the battery loading section of the video camera.

Fig. 11 is a side view showing the state in which the battery device is being loaded on the battery loading section of the video camera.

Fig. 12 is a side view showing an engagement boss of the battery loading section being engaged

in an opening in the battery device.

Fig.13 is a side view showing the battery device loaded on the battery loading section.

Fig.14 is a side view showing the battery device loaded on the battery loading section in a mistaken manner.

Fig.15 is a side view showing the state in which a first battery device housing two cells is being loaded on the battery loading section.

Fig.16 is a front view showing the state in which the first battery device is being loaded on the battery loading section.

Fig.17 is a side view showing the state in which the first battery device is being loaded on the battery loading section.

Fig.18 is a side view showing the state in which the first battery device has been loaded on the battery loading section.

Fig.19 is a side view showing the state in which the first battery device has been loaded on the battery loading section in the reverse direction.

Fig.20 is a side view showing the state in which the first battery device has been loaded on the battery loading section at an incorrect inserting position.

Fig.21 is a front view showing the state in which the first battery device has been loaded on the battery loading section at an incorrect inserting position.

Fig.22 is a front view showing the state in which the first battery device has been inserted with deviation towards an upper side of the battery loading section.

Fig.23 is a front view showing a modification of the battery device according to the present invention.

Figs.24 and 25 are perspective views showing other modifications according to the present invention, respectively.

Fig.26 is a perspective view showing the first battery device housing two cells.

Fig.27 is a transverse cross-sectional view showing the first battery device shown in Fig.26.

Fig.28 is a side view showing the first battery device shown in Fig.26.

Fig.29 is a perspective view of a video camera having a battery loading section on which the first battery device shown in Fig.26 is loaded.

Fig.30 is a perspective view showing a second battery device housing four cells.

Fig.31 is a transverse cross-sectional view showing the second battery device shown in Fig.30.

Fig.32 is a transverse cross-sectional view showing the second battery section on which the second battery device is loadable.

Fig.33 is a transverse cross-sectional view showing the state in which the first battery device

has been loaded on the battery loading section on which the second battery device is loadable.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings, illustrative embodiments of a battery device according to the present invention and an electronic equipment on which the battery device may be loaded will be explained in detail.

A battery device 31 of the present embodiment houses four cylindrically-shaped rechargeable cells 1. The battery device 31 includes a housing unit 33 constituting a cell housing section 32 having a size sufficient to accommodate four cells 1 in vertically and transversely juxtaposed state therein as shown in Figs.1, 2 and 3. The housing unit 33 is made up of an upper casing half 34, a mid casing half 35 and a terminal mounting plate 36. The terminal mounting plate 36 constitutes a bottom plate of the housing unit 33 and has embedded therein a positive terminal 37 and a negative electrode terminal 38 for electrical connection to connection terminals of an electronic equipment on which the battery device 2 may be loaded. The upper casing half 34, mid casing half 35 and the terminal mounting plate 36 are molded separately from an electrically insulating synthetic resin and abutted and coupled to one another. The cell housing section 32 of the housing unit 33 defining therein a space sufficient to hold the four cells 1 is constituted by the upper casing half 34, the mid casing half 35 and the terminal mounting plate 36 being abutted and coupled to one another.

The four cells 1 are housed within the cell housing section 32 by being arrayed in juxtaposition to each other in the vertical and transverse directions, as shown in Figs.2 and 3. In this preferred embodiment, the upper casing half 34, mid casing half 35 and the terminal mounting plate 36 have respective abutment surfaces thereof bonded or fused to one another, with the four cells 1 contained therein, for making up the housing unit 33.

The terminal mounting plate 36 constituting the bottom plate of the housing unit 33 has embedded therein the positive terminal 37 and the negative terminal 38 for electrical connection to the connection terminals of the electronic equipment on which the battery device 31 of the present embodiment is to be loaded. The terminal mounting plate also has a jumper wire, not shown, for electrically connecting the positive and negative terminals 37, 38, and electrode plates. The positive terminal 37 and the negative terminal 38 provided on the terminal mounting plate 36 are formed as tubes so that pin-shaped connection terminals provided on the elec-

tronic equipment on which the battery device 31 is loaded may be inserted therein so as to be electrically connected thereto, as shown in Figs.1 and 2. The positive terminal 37 and the negative terminal 38 in the form of tubes are mounted on both sides of an end face of the terminal mounting plate 36 with opening ends 37a, 38a being opened in an end face 41 of the battery device 31 along the direction of inserting the battery device 31 into the electronic equipment.

The above-described battery device 31 is formed so as to be substantially parallelepipedic in conformity to the outer shape of the four cells 1 arranged in juxtaposition to each other in two rows in the vertical and transverse directions. Both sides of the upper casing half 34 constituting the upper side 39 of the housing unit 33 opposite to the bottom side integrally formed with the terminal mounting plate 36 are arcuate in profile in conformity to the outer periphery of the cells 1 contained in the cell housing unit 32. By the arcuate portions 40, 40 being formed on both sides of the upper surface 39, the battery device 31 is non-symmetrical in shape in the vertical direction to permit facilitated discrimination of the up-and-down direction.

The battery device 31 of the embodiment illustrated has on its both lateral sides 42, 43 first and second grooves 44, 45 for engagement by first and second ribs provided on the battery mounting section of an electronic equipment on which the battery device 31 is to be loaded, as shown in Figs.1 and 2. The lateral sides 42, 43 extend at right angles to the end face 41 on the side of insertion into the electronic equipment on which the opening ends 37a, 38a of the positive terminal 37 and the negative terminal 38 are opened. These first and second grooves 44, 45 are formed parallel to the direction of insertion of the battery device 31 into the electronic equipment at a mid position in the vertical direction at right angles to the inserting direction of the housing unit 33 into the electronic equipment. Further, the first and second grooves 44, 45 are formed so as to extend from the forward end face 41 in the inserting direction to a mid portion of the housing unit 33 so that opening ends 44a, 45a thereof are opened on the forward end face 41. That is, the first and second grooves 44, 45 are formed in parallel with the inserting direction of the battery device 31 so that the opposite ends thereof towards a rear end face 46 opposite to the forward end face 41 are closed.

Specifically, the first and second grooves 44, 45 are formed so that portions of the mid casing 35 constituting the housing unit 33 are extended towards a space defined between the set of cells 1<sub>1</sub>, 1<sub>3</sub> and 1<sub>2</sub>, 1<sub>4</sub> arranged vertically in juxtaposition in the cell housing section 32, as shown in Fig.3.

Since the first and second grooves 44, 45 are formed in this manner between the cells 1<sub>1</sub>, 1<sub>3</sub> and 1<sub>2</sub>, 1<sub>4</sub> arranged vertically in juxtaposition to each other, the grooves 44, 45 are positioned at a mid position along the height of the housing unit 33 housing the four cells 1 arranged in juxtaposition and parallel to each other in the vertical and transverse directions.

In an upper wall section of the upper casing half 34 constituting the upper surface 39 of the housing unit 33 extending at right angles to the lateral surfaces 42, 43 and the forward end face 41 of the housing unit 33 is formed a third groove 51 for engagement by a third rib provided on the battery loading section of the electronic equipment on which the battery device 31 is to be loaded, as shown in Fig.1. The third groove 51 is formed at a mid position along the width of the housing unit 33 parallel to the inserting direction from the forward end face 41 as far as a mid position of the housing unit 33 so that its opening end 51a is opened in the forward end face 41. That is, the third groove 51 has its end towards the rear end face of the housing unit 33 closed and is formed parallel to the inserting direction of the battery device 31 into the electronic equipment. The third groove 51 plays the role of inhibiting mistaken insertion of the battery device 31 into the battery loading section.

The forward end face 41 in the inserting direction of the housing unit 33 is formed with a hole 52 for engagement by an engagement boss provided on the battery loading section of the electronic equipment on which the battery device 31 is loaded, as shown in Fig.1. The hole 52 is formed in the space not opposed by any end faces of the four cells 1<sub>1</sub> to 1<sub>4</sub> arranged in juxtaposition to each other in the vertical and transverse directions in the cell housing section 32, that is in the space defined between the four cells 1<sub>1</sub> to 1<sub>4</sub> arranged in juxtaposition to each other in the vertical and transverse directions in the cell housing section 32. The hole 52 is formed for extending from the forward end face 41 of the housing unit 33 inwardly into the interior of the battery loading section 32.

The hole 52 is of a substantially triangular cross-section, as shown in Fig.3. The hole 52 is formed so that its lower side 52a is substantially coincident with a line P<sub>1</sub> interconnecting upper edges of the cells 1<sub>1</sub>, 1<sub>2</sub> arranged on the bottom surface of the housing unit 33 and its apex 52b is intruded into a space between the cells 1<sub>3</sub>, 1<sub>4</sub> arranged on the upper surfaces of the cells 1<sub>1</sub>, 1<sub>2</sub> arranged on the bottom surface of the housing unit 33, as shown in Fig.4. The hole 52 is formed in order to permit the engagement boss engageable in the hole 52 to be engaged in the mistaken-insertion inhibiting groove 11 on the upper surface of the first battery device 2 holding two cells 1



when the battery device 2 is loaded on the battery loading section.

The hole 52 has its maximum diameter  $R_1$  in the cross-sectional direction shallower than its depth  $D_1$ , as shown in Figs.2 and 4. That is, the hole 52 has its depth  $D_1$  deeper than the radius  $R_1$  of the opening end 52a. The reason therefor is that the engagement boss provided on the battery loading section for engagement in the hole 52 is of an elongated length in order to play the role of a guide for loading the battery device 31 on the battery loading section.

In addition, the hole 52 has its depth  $D_1$  deeper than the length  $L_1$  of the cylindrical positive and negative terminals 37 and 38 provided on the terminal mounting plate 36. The reason therefor is to enable the length of the engagement boss provided on the battery loading section for engagement in the hole 52 to be longer than the length of the connecting pins engaged with the positive and negative terminals 37, 38 as connecting terminals, so that the positive and negative terminals 37, 38 are engaged with the connecting pins after positioning the battery device 31 with respect to the battery loading section.

The battery device 31 of the illustrated embodiment has, on both lateral sides of the terminal mounting plate 36 constituting the bottom plate of the housing unit 33, sets of engagement grooves 54, 55, engaged by engagement pieces, not shown, provided on the externally mounted type battery loading section, in order to permit the battery device 31 to be loaded not only on the battery loading section provided within the electronic equipment but also on the externally mounted type battery loading section provided on the outer surface of the electronic equipment, as shown in Figs.1, 2 and 5. These engagement grooves 54, 55 are partially opened in the bottom surface of the housing unit 33 in the shape of a letter U, in order to be engaged by a sliding movement by L-shaped engagement pieces provided on the externally mounted battery loading unit, as shown in Figs.1 and 5. In the bottom surface 59 of the housing unit 33 are formed plural positioning holes 56, 57 engaged by elastically deformable engagement pieces and positioning protrusions provided on the bottom surface of the externally mounted battery loading section, as shown in Fig.5. In the bottom surface of the housing unit 33 is formed a use state display window 58 which is moved by a movement member on the battery loading section when the battery device is loaded thereon for indicating that the housing unit has once been loaded and used on the battery loading section, as shown in Fig.5.

Turning to a video camera 61 as an electronic equipment on which the battery device 31 of the embodiment illustrated may be used, there is

mounted a battery loading section 63 in a portion of an outer casing 62 constituting a main body of the video camera, as shown in Fig.6. The battery loading section 63 is delimited by partitioning a portion of an outer casing 62 by a casing member 64. The casing member 64 constituting the battery loading section 63 has an entrance/exit opening 65 for association with the forward end face 41 in which the positive terminal 37 and the negative terminal 38 of the battery device 31 are accessible at 37a, 38a, respectively, as shown in Figs.7 and 8. The entrance/exit opening 65 is contoured in conformity to the forward end face 41 of the battery device 31. The battery loading section 63 constituted within the casing 64 is sized to enclose the battery device 31 therein, as shown in Fig.7.

On opposite inner lateral sides 66, 67 of the battery loading section 63 are formed first and second ribs 68, 69 for engagement in the first and second grooves 44, 45 formed in opposite lateral sides of the battery device 31 to be loaded on the battery loading device 63. These first and second ribs 68, 69 are formed so as to be parallel to the loading direction of the battery device 31 so that the ends of the ribs face the vicinity of the entrance/exit opening 65. The first and second ribs 68, 69 are of a length sufficient to be engaged in the first and second grooves 44, 45 substantially along the entire lengths thereof.

On an upper surface 70 of the battery loading section 63 extending parallel to the inserting direction of the battery device 31 and at right angles to the opposite inner lateral sides 66, 67 of the loading section 63 is formed a third rib 71 for engagement in a third groove 51 formed in the upper surface of the battery device 31. Similarly to the first and second ribs 68, 69, the third rib 71 is formed parallel to the loading direction of the battery device 31, with the end thereof disposed in the vicinity of the entrance/exit opening 65, and has a length sufficient to be engaged in the third groove 51 over substantially the entire length thereof.

On an inner end face 72 of the battery loading section 63 facing the inserting direction of the battery device 31 is formed an engagement boss 73 adapted to be engaged in the hole 52 formed in the forward end face 41 of the battery device 31. The engagement boss 73 is of a cross-sectional shape corresponding to that of the hole 52 of the battery device 31. That is, the engagement boss 73 is formed to have a substantially triangular cross-section, as shown in Fig.9. In addition, on the inner end face 72 of the battery loading section 63 facing the battery device 31 being inserted are formed connection pins 74, 75 constituting connection terminals adapted to be engaged by and electrically connected to the tubular positive and negative terminals 37, 38 of the battery device 31 opened at

37a, 38a in the forward end face 41 of the battery device 31. The engagement boss 73 has its length  $L_2$  longer than the length  $L_1$  of the positive and negative terminals 37, 38 of the battery device 31 or the length  $L_3$  of the connection pins 74, 75 provided on the battery loading section 63, as shown in Fig.8. The length  $L_2$  of the engagement boss 73 is 15 mm, while the length  $L_3$  of the connection pins 74, 75 is 6 mm. The length  $L_3$  of the connection pins 74, 75 is not limited to 6 mm if only it is lesser than the length  $L_2$  of the engagement boss 73 and assures positive engagement of the connection pins 74, 75 with the positive and negative terminals 37, 38. Similarly, the length  $L_2$  of the engagement boss 73 is not limited to 15 mm if it is longer than the length  $L_3$  of the connection pins 74, 75.

On the rear end face 72 of the battery loading section 63 opposite to the inserting direction of the battery device 31, there is provided an elastic member 77 for ejecting the battery device. The elastic member 77 is constituted by a coil spring in which the force biasing the battery device 31 out of the battery loading section 63 is stored. On the entrance/ exit opening 65 of the casing 64, there is provided a lock member 78 partially protruded into the entrance/ exit opening 65 for holding the battery device 31 loaded on the battery loading section 63 in the battery loading section 63 against the bias of the elastic member 77. The lock member 78 is mounted with a spring bias in a direction shown by arrow G in Fig.7 so that its retention portion 79 protruded at its lateral side is protruded into the entrance/exit opening 65 by a bias member, not shown. The lock member 78 is thrust by the battery device 31 inserted into the battery loading section 63 so as to be moved in a direction shown by arrow G in Fig.7 against the bias of the bias member. When the battery device 31 is loaded on the battery loading section 63, the lock member 78 is moved under the bias of the bias member in the direction shown by arrow G in Fig.7 for retaining a portion of the opposite side end face 46 of the battery device 31 by the lock member 78 for locking the battery device in the battery loading section 63.

The lock member 78 is provided at a position capable of locking the battery device 2 in the battery loading section 63 when the second battery device 2 housing two cells 1 is housed within the housing unit 33, as explained subsequently.

For taking out the battery device 31 loaded on the battery loading section 63, the lock member 78 is moved in the direction opposite to that shown by arrow G in Fig.7, against the bias of the bias member, for releasing the lock by the retention member 79. Thus the battery device 31 is ejected via the entrance/ exit opening 65 under the bias of

the elastic member 77.

On the casing 64 is rotatably mounted a lid 80 via a hinge 81 for opening or closing the entrance/exit opening 65, as shown in Fig.7. The lid 80 closes the battery loading section 63 and, when the battery device 31 is not loaded in position, prevents intrusion of dust and dirt into the inside of the battery loading section 63. When the battery device 31 is loaded in position, the lid prevents the battery device 31 from being inadvertently detached from the battery loading section 63.

On the rear end face 72 of the battery loading section 63 in the inserting direction of the battery device 31, there is provided a movement member 82 for moving the use state display member 58 provided on the battery device 31 loaded on the battery loading section 63.

For loading the battery device 31 on the above-described battery loading section 63, the battery device is inserted via the entrance/ exit opening 65 with the first and second grooves 44, 45 in registration with the first and second ribs 68, 69, the third groove 51 in registration with the third rib 71 and with the bottom surface 59 of the housing unit 33 lying on the bottom surface 76 within the battery loading section 63, as shown in Fig.10. At this time, the battery device 31 has its bottom surface 59 lying on the bottom surface 76 within the battery loading section 63. If the battery device 31 is inserted from this position further in the direction X in Fig.11, the first and second grooves 44, 45 are engaged by the first and second ribs 68, 69, respectively, while the third groove 51 is engaged by the third rib 71. With the first, second and the third grooves 44, 45 and 51 being engaged by the first, second and third ribs 68, 69 and 71, respectively, the battery device 31 is inserted into the battery loading section 63, with the controlled position and the direction of insertion, as shown in Fig.11.

When the battery device 31 is inserted in the direction shown by arrow X in Fig.11 from the state in which the first and second grooves 44, 45 and the third groove 51 are engaged by the first and second ribs 68, 69 and the third rib 71 into the inside of the battery loading section 63, as shown by arrow X in Fig.11, the hole 52 is engaged by the engagement boss 73, as shown in Fig.12. When the battery device 31 is further inserted into the inside of the battery loading section 63, as shown by arrow X in Fig.12, the positive terminal 37 and the negative terminal 38 are engaged with the connection pins 74, 75, as shown in Fig.13. This completes loading of the battery device on the battery loading section 63 to establish electrical connection with the video camera device 61 to enable the current to be supplied to the video camera 61.

In the course of the loading of the battery device 31 on the battery loading device 63, the elastic member 77 for ejecting the battery device is compressed, although not shown, for storing the force in the direction of ejecting the battery device from the battery loading section 63.

The battery device 31 loaded on the battery loading section 63 is locked therein by a portion of the rear end face 46 being retained by the retention portion 79 of the lock member 78. When the battery device 31 is loaded on the battery loading section 63, the use state display section 58 is moved by the movement member 82 for indicating that the battery device has once been loaded and used on the video camera 61.

The battery device 31 thus loaded on the battery loading section 63 is supported by the first and second grooves 44, 45 on its both sides being engaged by the first and second ribs 68, 69, so that it is prohibited from being moved within the battery loading section 63 and is loaded in stability. Above all, since the battery device 31 increased in weight by holding four cells 1, the video camera 61 is prohibited from being damaged by the wobbling of the battery device 31 even although a shock is applied to the video camera 61 having the battery device 31 loaded thereon.

On the other hand, since the engagement boss 73 engaged in the hole 52 of the battery device 31 is longer in length than the length  $L_1$  of the positive terminal 37 or the negative terminal 38 or the length  $L_3$  of the connection pins 74, 75, the engagement between the positive and negative terminals 37, 38 with the connection pins 74, 75 occurs after the first and second grooves 44, 45 are engaged by the first and second ribs 68, 69 and the hole 52 is engaged by the engagement boss 73 for positioning the battery device 31 with respect to the battery loading section 63. Thus the positive and negative terminals 37, 38 may be correctly engaged with the connection pins 74, 75, while protection may be made of the positive and negative terminals 37, 38 and the connection pins 74, 75.

The battery device 31 is inserted into the battery loading section 63 with the hole 52 being engaged by the engagement boss 73, so that the battery device 31 may be loaded on the battery loading section 63 without producing forced sliding contact of the outer peripheral surface of the housing unit 33 with the inner peripheral surface of the battery loading section 63. Thus it is possible to prevent the outer peripheral surface of the housing unit 63 from being scratched or rubbed by repeated insertion and removal of the battery device 31 into and out of the battery loading section 63. Since the hole 52 has its depth  $D_1$  deeper than the radius  $R_1$  of the opening end 52a, as explained

previously, it becomes possible to increase the length of the engagement boss 73 provided on the battery loading section 63 for being engaged with the hole 52 for improving the guide function during loading of the battery device 31 on the battery loading section 63.

If it is attempted to insert the battery device 31 into the above-described battery loading section 63, in the vertically topsy-turvy condition, the third groove 51 is not coincident with the third rib 71, with the foremost part of the third rib 71 being caused to bear against the end face 41 of the battery device 31 for prohibiting mistaken insertion of the battery device.

If it is attempted to insert the battery device 31 into the battery loading section 63 from the rear end face 46 opposite to the forward end face 41, the end faces of the first and second ribs 68, 69 or the third rib 71 are caused to bear against the rear end face 46 as shown in Fig.14, thereby prohibiting insertion of the battery device into the loading section 63. That is, since the sides of the first, second and third grooves 44, 45, 51 towards the end face 46 are closed, the first, second and third grooves 44, 45, 51 constitute a mistaken-insertion prohibiting mechanism along with the first, second and third ribs 68, 69 and 71.

If it is attempted to insert the battery device 31, with the rear end face 46 as the inserting end, with the battery loading section 63 forcibly spreading the casing 64 apart, the engagement boss 73 engaged in the hole 52 is caused to bear against the opposite end face 46 for inhibiting further insertion of the battery device into the battery loading section 63.

Into the battery loading section 63 it is possible to load the first battery device 2 of Fig. 26, housing the two cells 1, 1 arranged side-by-side, in a manner such as to prevent mistaken insertion. For loading the first battery device 2, it is inserted in such a manner that the forward end face 8 of the battery device 2, in which the positive and negative terminals 5 and 6 are exposed at 5a and 6a, is caused to face the entrance/ exit opening 65, and the bottom side of the battery device is caused to slide on the bottom surface 76 within the battery loading section 63, as shown in Fig.15. The battery device is inserted in the direction indicated by arrow X in Fig.15 in such a manner that the arcuate portions 10, 10 formed on both sides of the upper surface 9 of the first battery device 2 are supported in abutment contact with the lower edges of the first and second ribs 68, 69 formed on both lateral sides 66, 67 of the battery loading section 63 for preventing the first battery device 2 from being floated from the bottom surface 76 of the battery loading section 63, as shown in Figs. 16 and 17. As the first battery device 2 is further inserted onto the

battery loading section 63, the engagement boss 73 is engaged with the mistaken-insertion inhibiting groove 11 formed in the upper surface 9. By the first battery device 2 being supported by the first and second ribs 68, 69 and by the engagement boss 73 being engaged in the mistaken-insertion inhibiting groove 11, the first battery device 2 is loaded on the battery loading section 63 while being controlled as to its loading position on the bottom surface 76 of the battery loading section 63. When the first battery device 2 is further inserted in the direction indicated by arrow X in Fig.18, from the state in which the engagement boss 73 is engaged in the mistaken-insertion inhibiting groove 11, the positive and negative terminals 5, 6 are engaged with the connection pins 74, 75. Since the first battery device 2 is loaded within the battery loading section 63 by being supported in position by the first and second ribs 68, 69 and the engagement boss 73, it becomes possible to establish the engagement of the positive and negative terminals 5 and 6 with the connection pins 74, 75, thereby assuring protection of the positive terminal 37 and the negative terminal 38 and the connection pins 74, 75.

When the first battery device 2 is inserted as shown in Fig.19 with the planar end face 8a opposite to the end face 8 of the battery device 2 in which the mistaken-insertion inhibiting groove 11 is opened, as the inserting end, the distal end face of the engagement boss 73 is caused to bear against a portion of the end face 8a to inhibit mistaken insertion.

If the first battery device 2 is inserted from the forward end face 8, but with a distance from the bottom surface 76 towards the upper surface 70 of the battery loading section 63, the first battery device is caused to bear against the end face of the engagement boss 73 to prevent mistaken insertion of the first battery device 2, as shown in Fig. 20.

If the first battery device 2 is inserted at an inclined position along the diagonal line of the battery loading section 63, as shown in Fig.21, part of the forward end face 8 or the rear end face 8a of the battery device is caused to bear against the end face of the engagement boss 73, thereby inhibiting mistaken insertion of the first battery device 2.

If the first battery device 2 is inserted in a direction normal to the battery loading section 63, that is along one of the inner lateral surfaces 66, 67, such as the inner lateral surface 66, part of the forward end face 8 or the rear end face 8a of the battery device is caused to bear against the end face of the first and second ribs 68, 69 or the end face of the engagement boss 73 thereby inhibiting mistaken insertion of the first battery device 2, as

shown in Fig. 22.

The housing unit 33 of the battery device 31 in the above-described embodiment is constituted by stacking the mid casing half 35 and the upper casing half 34 on the terminal mounting plate 36. However, a pair of vertically partitioned casing halves 134, 135 may be provided on the terminal mounting plate 36 and abutted and bonded to each other, as shown in Fig.23. The housing unit 33 may also be formed by abutting and connecting the lower casing half 233, a mid casing half 235 and an upper casing half 234 to one another and integrally attaching a terminal mounting plate 236 having the positive terminal 37 and the negative terminal 38 embedded therein to one end face of the resulting unit 33, as shown in Fig.24. In these cases, the first and second grooves 44, 45 and the third groove 51 as well as the hole 52 are provided as in the case of the battery device 31.

The housing unit 33 may be integrally molded from the upper casing half 34, mid casing half 35 and the terminal mounting plate 36, in which case the cell 1 is insert-molded in the molding metal die and housed in the housing unit 33 simultaneously with the molding of the housing unit 33.

If it is intended only to prevent the battery device 31 and the first battery device 2 from being inserted in a mistaken manner into the battery loading unit 63, there is no necessity of providing the first and second grooves 44, 45, as shown in Fig.25, since the mistaken insertion can be prohibited by the hole 52 and the engagement boss 73.

If it is intended to prevent mistaken insertion of the battery device into the battery loading section enabling the loading only of the sole battery device by the hole 52 and the engagement boss 73, the battery device may be such device housing two or four or more cells 1, without being limited to the device housing four cells.

## Claims

1. A battery device (31) comprising  
a housing unit (33) having a cell housing unit (32), and  
first and second grooves (44, 45), formed on, and extending longitudinally along, respective lateral surfaces of the cell housing unit at a mid height thereof, said first and second grooves having opening ends in a forward end face (41) of the cell housing unit.
2. The battery device as claimed in claim 1 wherein the first and second grooves are closed at rear ends thereof.
3. The battery device as claimed in claim 1 further comprising a third groove (51) on a top

- surface (39) of the housing unit at a mid position along the width of the housing unit, said third groove being opened in the forward end face (41) of the housing unit and extending from the forward end face as far as a mid portion of the housing unit. 5
4. The battery device as claimed in claim 1 wherein a hole (52) is formed in a portion of the forward end face (41) of the housing unit which is not opposed by end faces of cells when cells (1) are housed within the housing unit. 10
  5. The battery device as claimed in claim 1 wherein the housing unit is dimensioned to hold four tubular cells (1) in juxtaposition in parallel in vertical and transverse directions. 15
  6. The battery device as claimed in claim 1 wherein the first, second and third grooves (44, 45, 51) are formed in spaces which are defined in the cell housing unit between cells (1) when cells arranged in juxtaposition and parallel to each other are housed in the housing unit. 20 25
  7. The battery device as claimed in claim 1 wherein connection terminals (37a, 38a) for electrical connection to connection terminals provided on electronic equipment are provided on the forward end face (41) of the housing unit, the battery device being adapted for insertion forward end face foremost into the electronic equipment. 30
  8. A battery device comprising a housing unit having a cell housing section (32), and a hole (52) formed and extending inward at a position on the forward end face (41) of the cell housing section which is not opposed by end faces of cells (1) when cells are housed within the cell housing section. 35 40
  9. The battery device as claimed in claim 8 wherein the cell housing section (32) is dimensioned to hold four tubular cells (1) in juxtaposition and parallel to each other in vertical and transverse directions, said hole (52) being formed at positions in the space which is delimited between cells when cells arranged in juxtaposition and parallel to each other are housed in the cell housing section. 45 50
  10. The battery device as claimed in claim 1 wherein the hole (52) is substantially triangular in cross-section. 55
  11. The battery device as claimed in claim 1 wherein the hole (52) has a maximum length in the cross-sectional direction smaller than its depth.
  12. The battery device as claimed in claim 1 further comprising connection terminals (37a, 38a) for electrical connection to connection terminals provided on electronic equipment.
  13. An electronic equipment (61) comprising a main body of the electronic equipment having a casing including a battery loading section (63) dimensioned to hold a battery device (31) comprising a housing unit having a battery housing section containing four tubular cells in vertical and transverse directions in parallel and juxtaposition with one another, said battery device having first and second grooves on opposite lateral surfaces thereof extending parallel to the direction of insertion of the battery device into the electronic equipment, said first and second grooves being at a mid height along the height at right angles to the direction of insertion and extending parallel to the direction of insertion from the forward end face of the housing unit to a mid portion of the housing unit so as to be opened in the forward end face of the housing unit, there being formed first and second ribs (68, 69) on opposite inner lateral sides of the battery loading section (63) for engagement by the first and second grooves of the battery device.
  14. The electronic equipment as claimed in claim 13 wherein a third rib (71) is formed on a surface of the battery loading section (63) extending at right angles to the opposite lateral sides of the battery loading section and in parallel with the direction of insertion of the battery device, said third rib being adapted for engagement in a third groove formed in a surface of the housing unit of the battery device extending at right angles to both lateral sides of the housing unit, said third groove extending in parallel with the direction of insertion into the battery loading section.
  15. The electronic equipment as claimed in claim 13 wherein an engagement boss (73) for engagement in a hole formed in the forward end face of the housing unit of the battery device is formed on an end face (72) of the battery loading section (63) lying in the inserting direction of the battery device.
  16. The electronic equipment as claimed in claim 13 wherein connection terminals (74, 75) for

electrical connection to connection terminals provided on a forward end face of the battery device are provided on an end face (72) of the battery loading section along the direction of insertion of the battery device.

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17. The electronic equipment as claimed in claim 13 wherein the connection terminals provided on the battery device and the battery loading device are connection pins and tubular connection terminals to be engaged by the connection pins (74, 75). 10
18. The electronic equipment as claimed in claim 16 wherein the engagement boss (73) for engagement in the hole formed in the battery device is longer in length than the connection pins (74, 75) or the tubular connection terminals provided in the battery device or in the battery loading section. 15 20

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FIG. 1

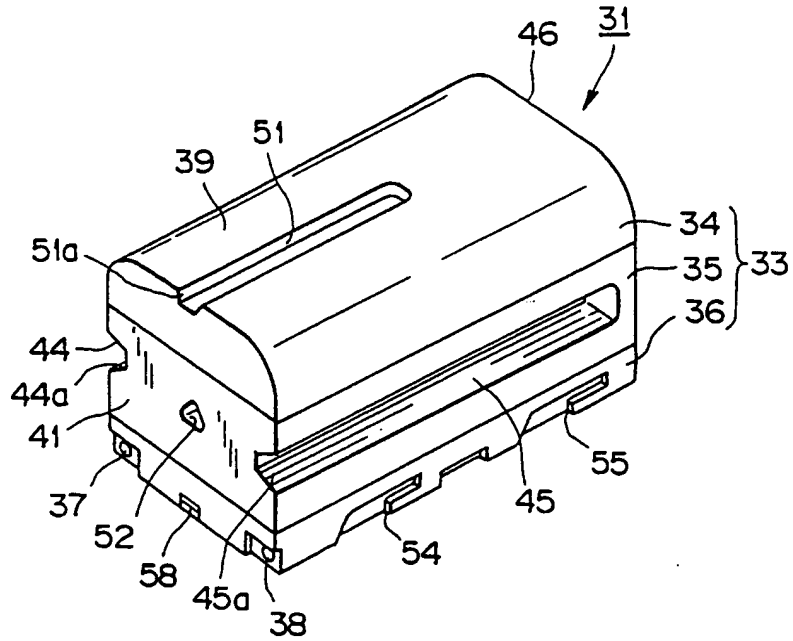


FIG. 2

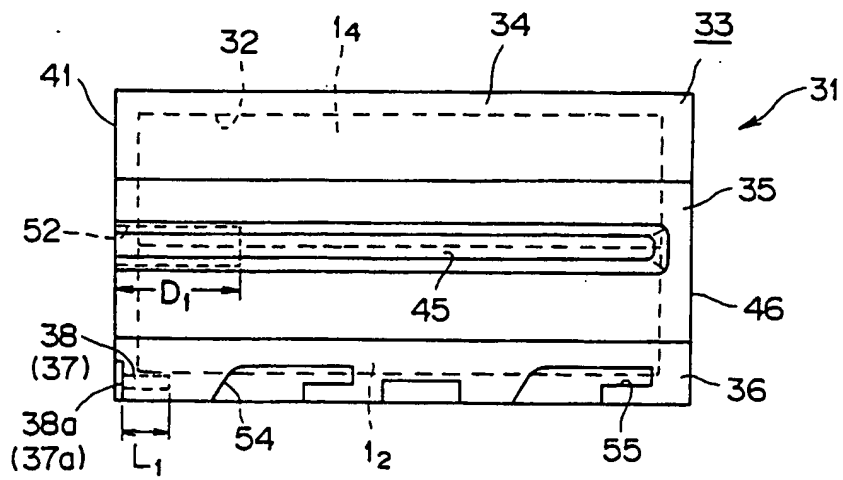


FIG. 3

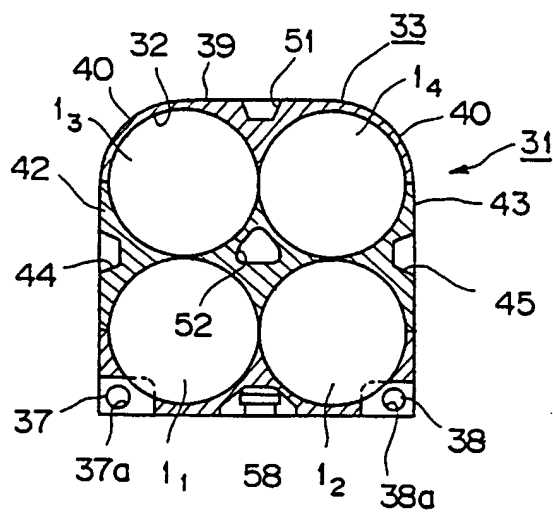


FIG. 4

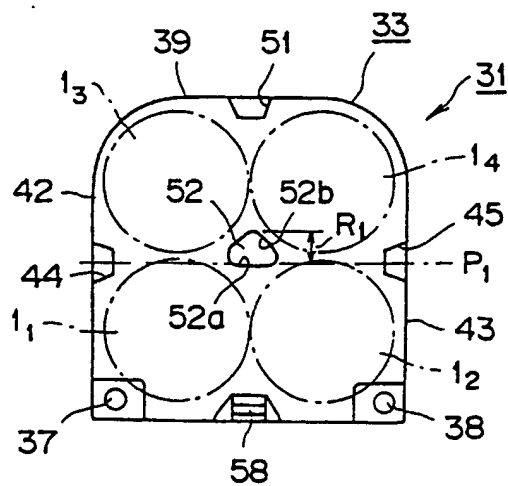




FIG. 5

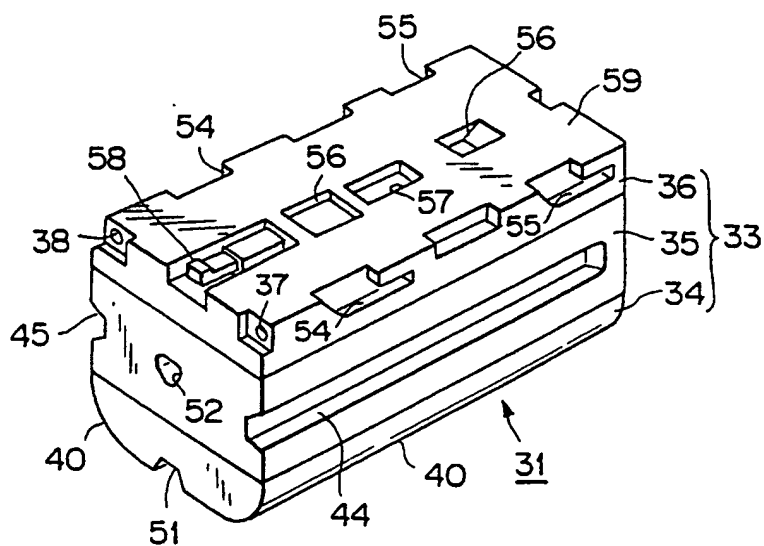


FIG. 6

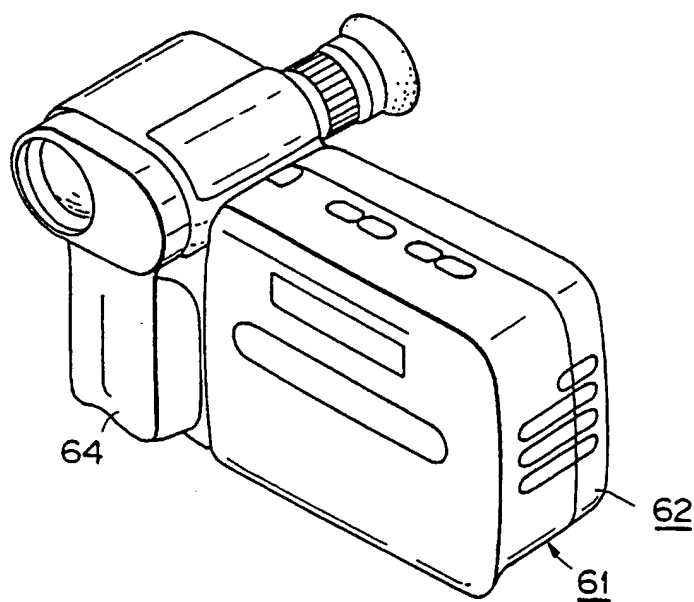


FIG. 7

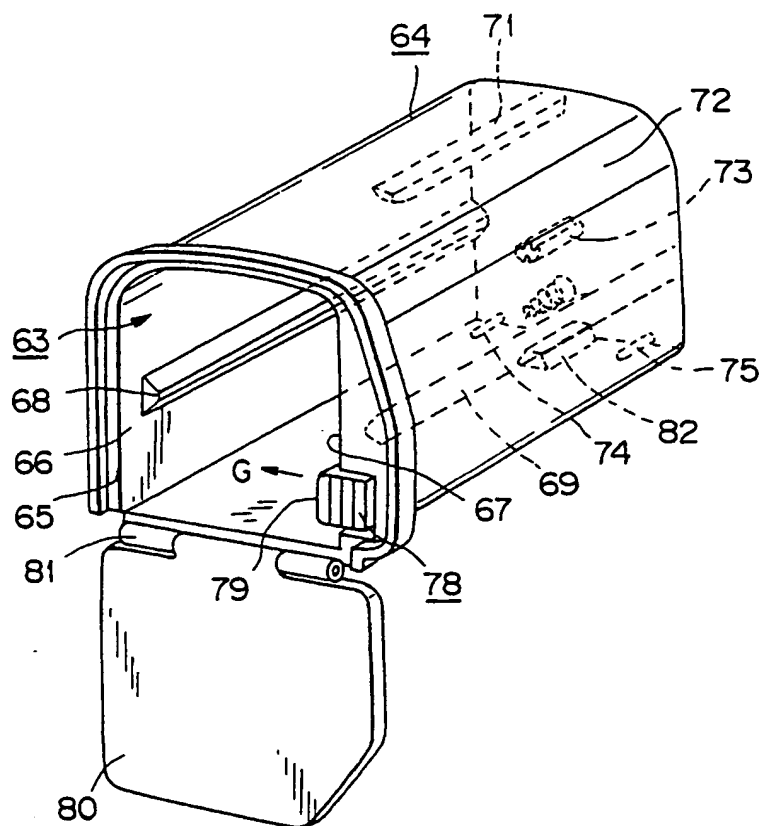


FIG. 8

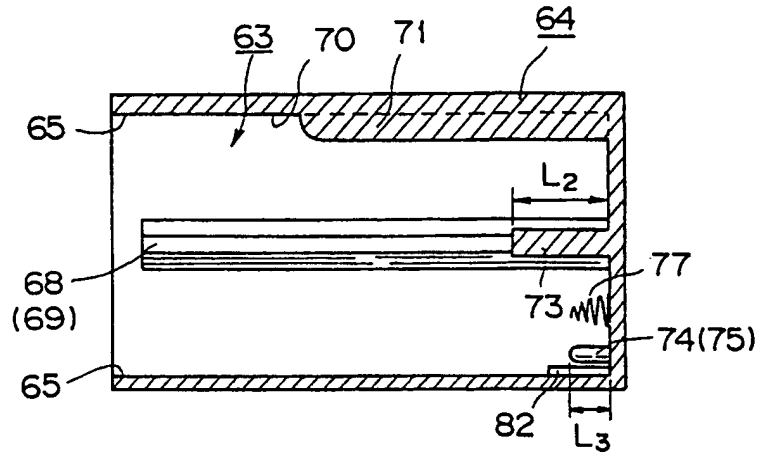


FIG. 9

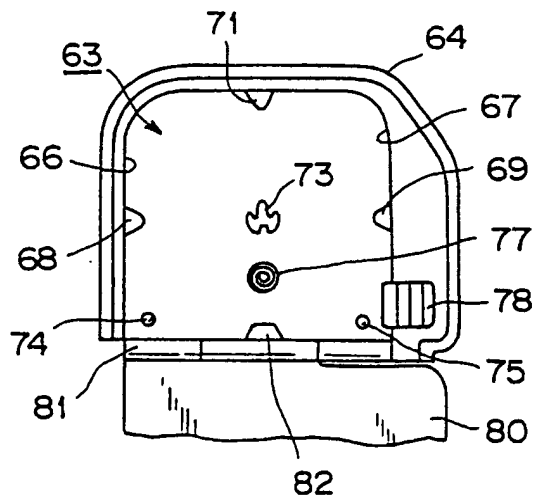


FIG. 10

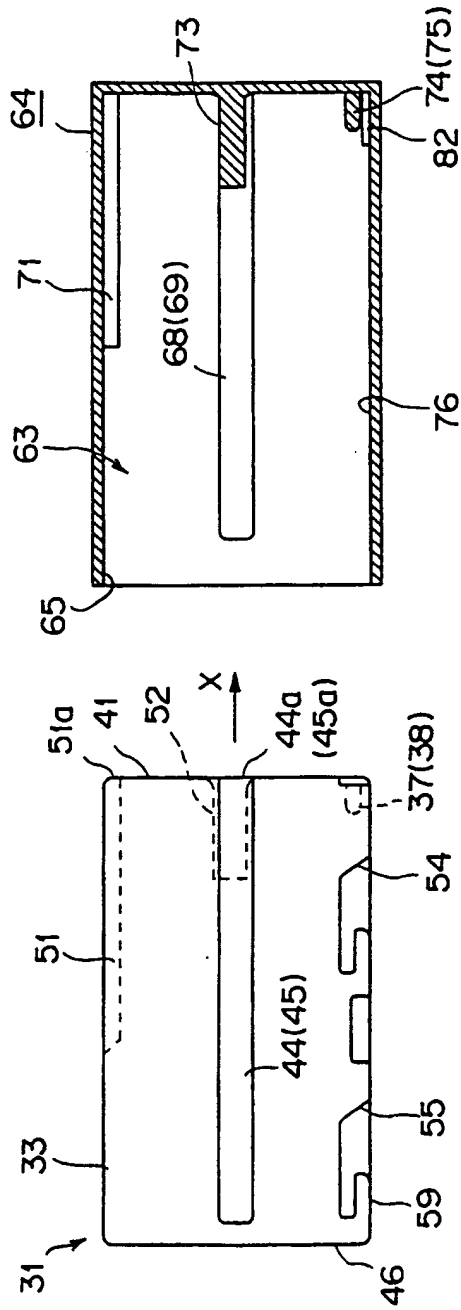


FIG.11

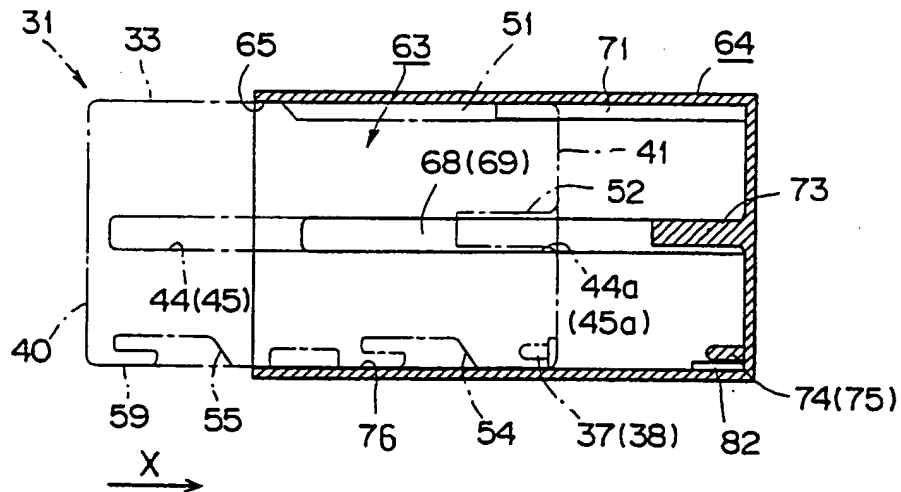


FIG.12

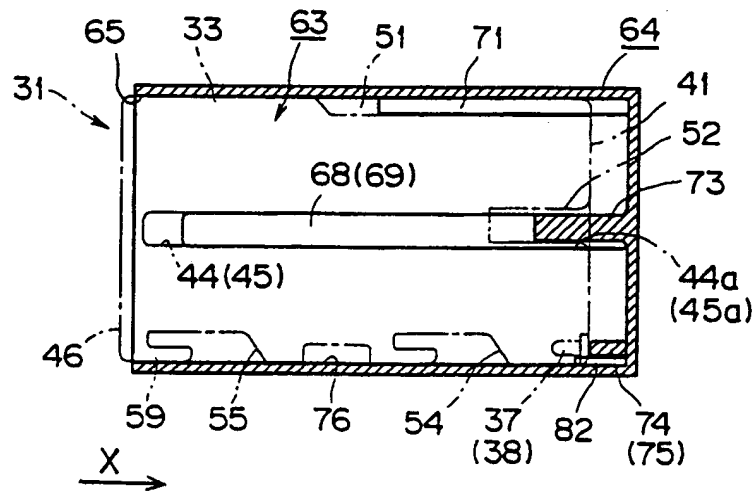


FIG. 13

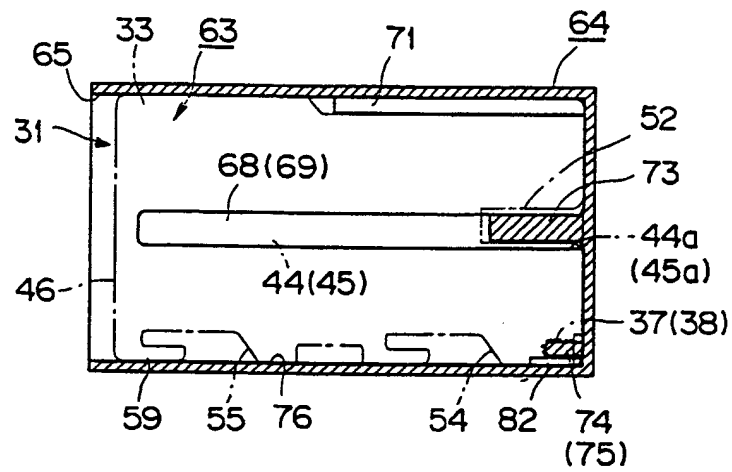


FIG. 14

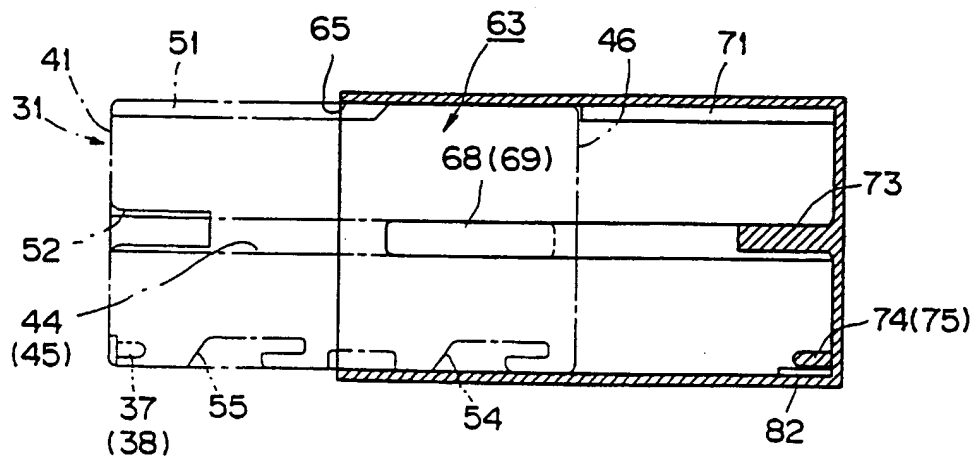


FIG. 15

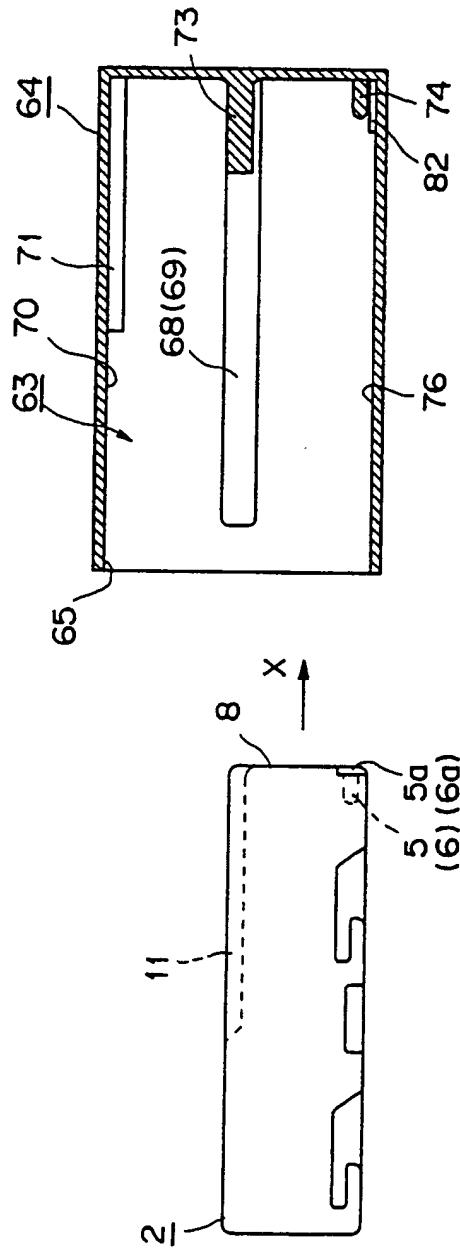


FIG.16

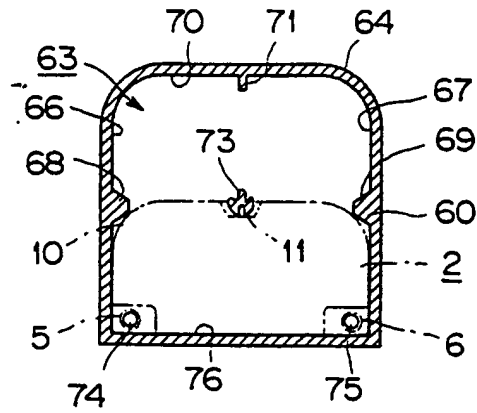


FIG.17

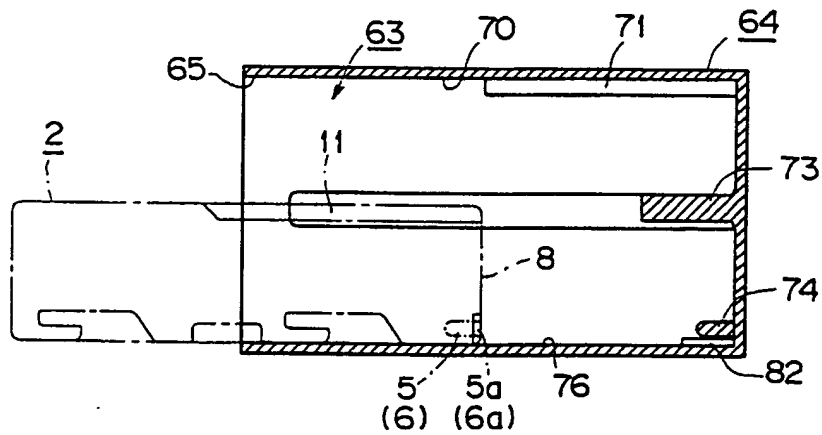


FIG.18

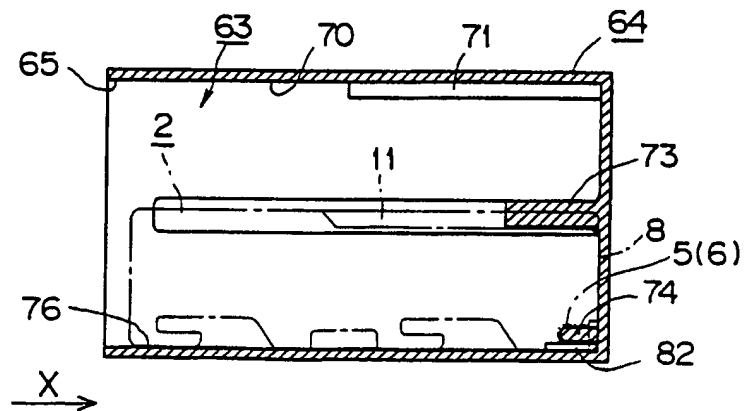




FIG. 19

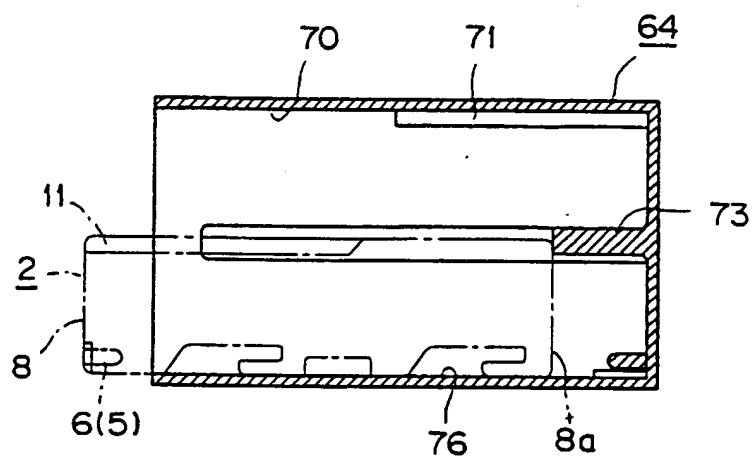


FIG. 20

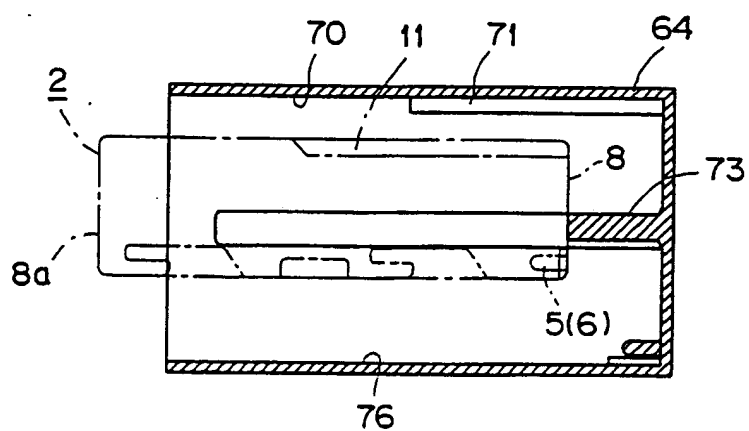


FIG. 21

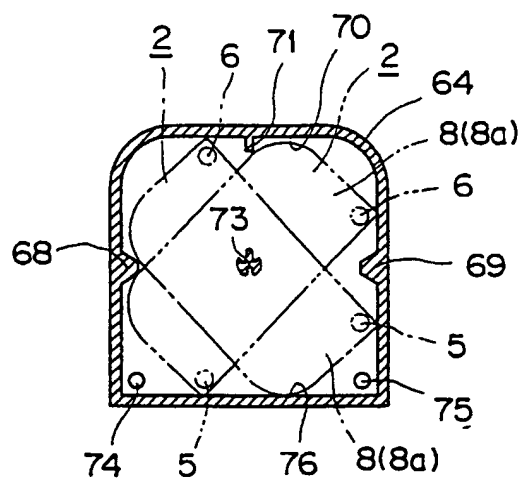


FIG. 22

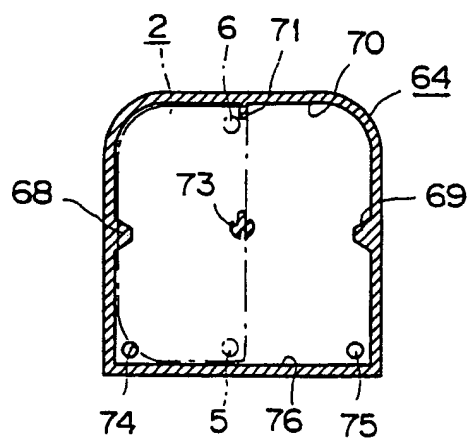


FIG. 23

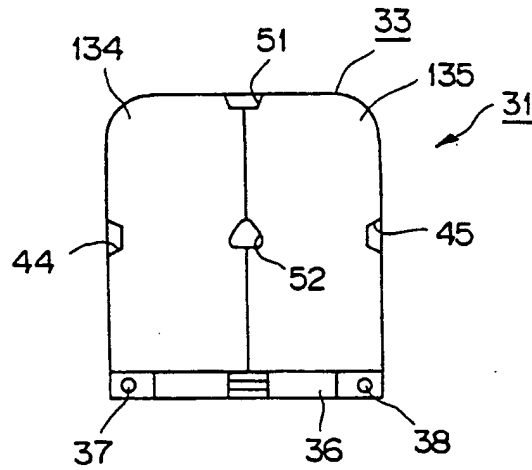


FIG. 24

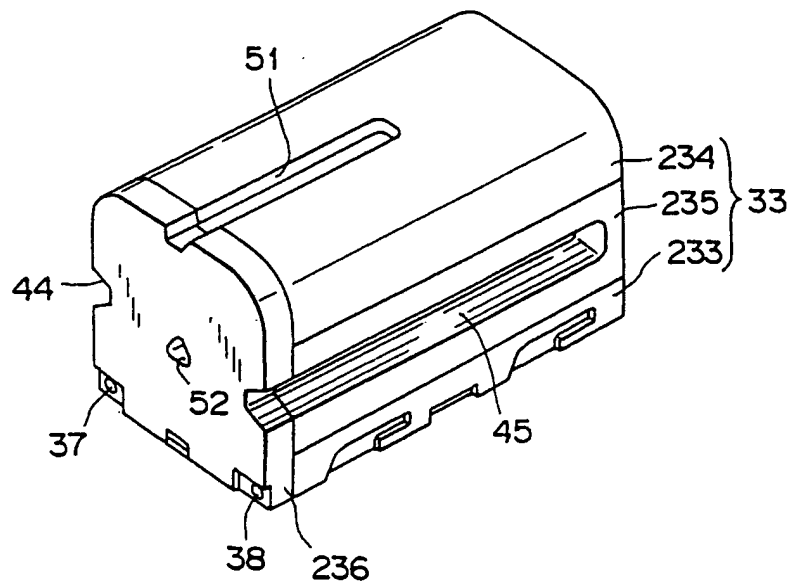


FIG. 25

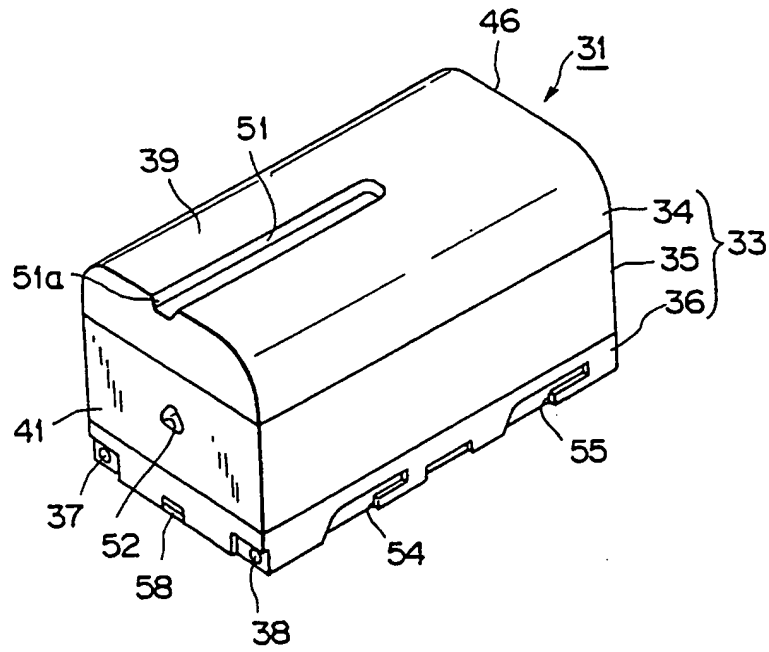


FIG. 26

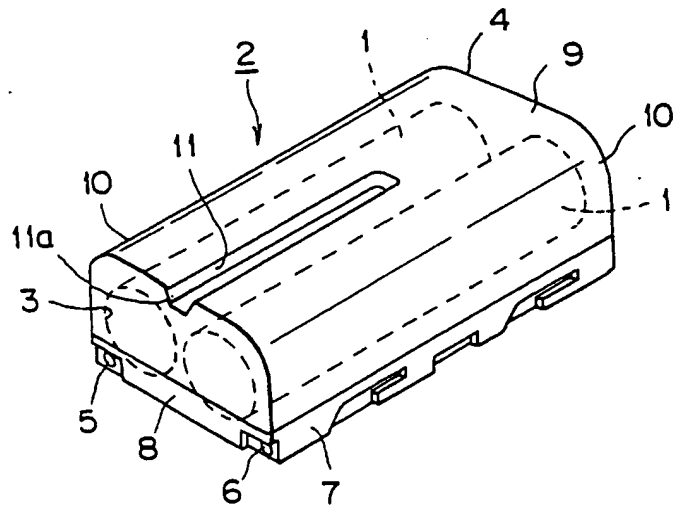


FIG. 27

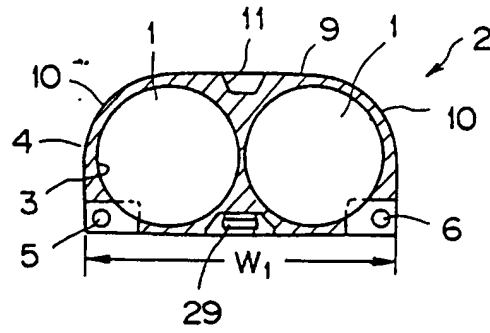


FIG. 28

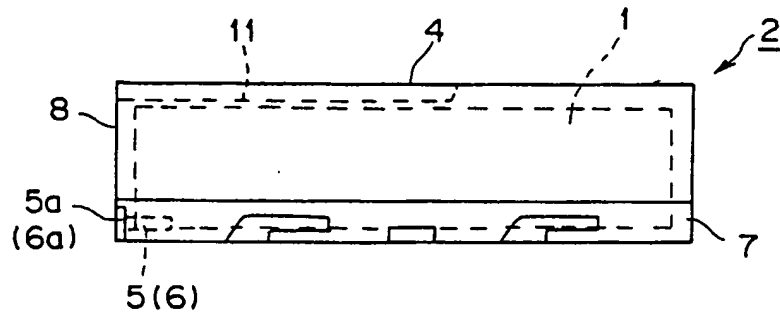


FIG. 29

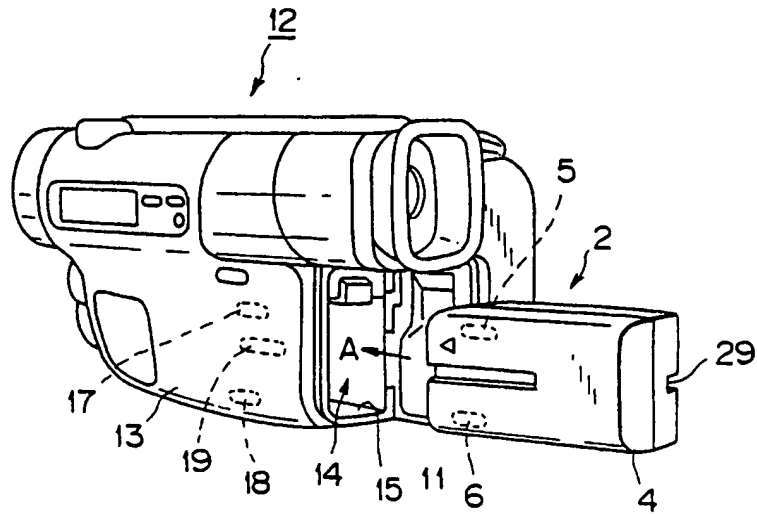


FIG. 30

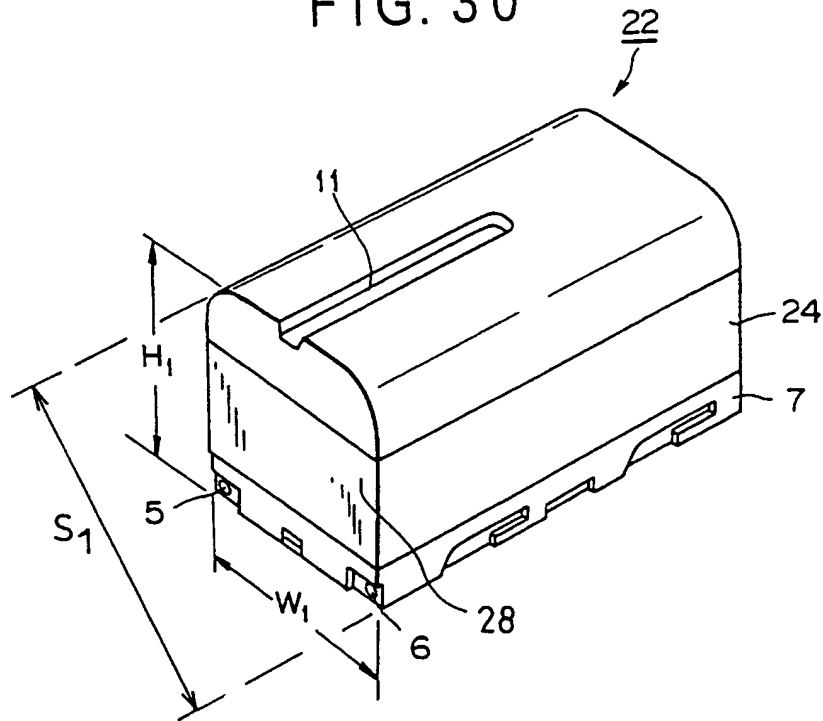


FIG. 31

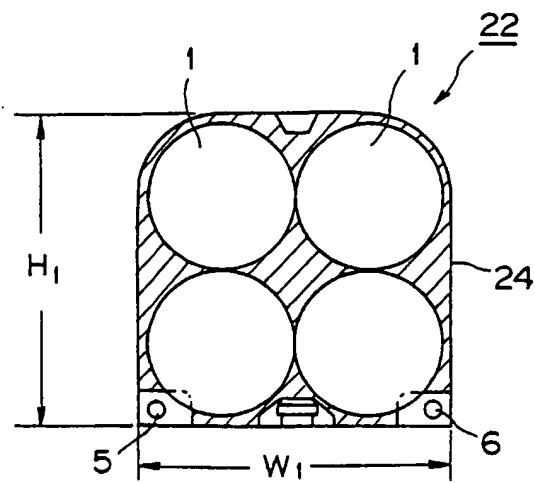


FIG. 32

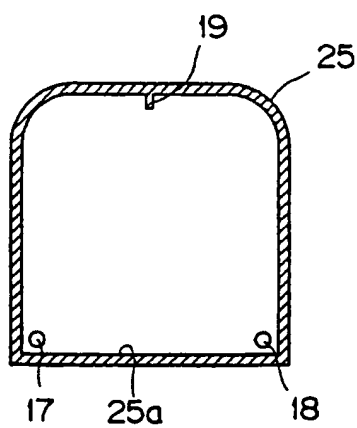


FIG. 33

